

APPENDIX E

WASTE COMPOSITION DATA

- 1. 2005 Outbound Residue Composition Data
- 2. 1995 Inbound MSW Composition Data

Palo Alto Waste Composition Study

Final Report

March 2006

Prepared by
Cascadia Consulting Group

4.6 SMaRT Station Residuals

The consultant team hand-sorted 30 samples of waste from the residuals pile at the SMaRT Station.

4.6.1 Key Findings

As shown in Figure 4-6, the sampling results suggest the following key findings about disposal trends and recovery potential for the residuals material stream.

- Over three-quarters (77%, 30,700 tons) of the SMaRT Station’s residuals are recyclable or compostable.
- Compostable materials account for about 36% (14,500 tons) of the SMaRT Station’s residuals, shown in green. These material categories included the following (Table 4-6):
 - Food (6,061 tons)
 - Compostable Paper (3,590 tons)
 - Prunings and Trimmings (161 tons)
 - Manure (38 tons)³
 - Leaves and Grass (4,186 tons)
 - Compostable Organics (332 tons)
 - Branches and Stumps (88 tons)
- About 40% (16,200 tons) of the SMaRT Station residual stream is recyclable, including recyclable paper (17%, 7,000 tons), shown in yellow, and other recyclables (23%, 9,200 tons), shown in blue.
- By weight, the five largest recyclable paper material categories include:
 - Newspaper (1,452 tons)
 - Other Misc. Paper (1,190 tons)
 - White Ledger (717 tons)
 - Magazines and Catalogs (1,261 tons)
 - Cardboard (1,119 tons)
- The five largest material categories considered in the grouping “other recyclables” are:
 - Rock, Soil, and Fines (2,177 tons)
 - Other Ferrous Metal (922 tons)
 - Misc. Plastic Containers (646 tons)
 - Gypsum Board (1,129 tons)
 - Textiles (672 tons)
- About 2% (900 tons) is potentially recyclable. The material categories considered potentially recyclable include:
 - Remainder/Composite Metal (626 tons)
 - Carpet (118 tons)
 - Other Rubber (189 tons)
- More than a fifth (21%, 8,400 tons) of the SMaRT station residuals sampled consists of problem materials. By weight, the five largest material categories are:
 - Other Film Plastics (2,027 tons)
 - Diapers (1,483 tons)
 - Remainder/Composite SW (719 tons)
 - Remainder/Comp. C&D (1,622 tons)
 - Wood-treated (947 tons)

³ For this study, the material category “manure” is considered “potentially compostable.”

- The sampling crew did not observe any reusable or repairable items in the SMaRT Station residual waste stream.

Figure 4-6. Waste Composition & Recoverability, SMaRT Station Residuals

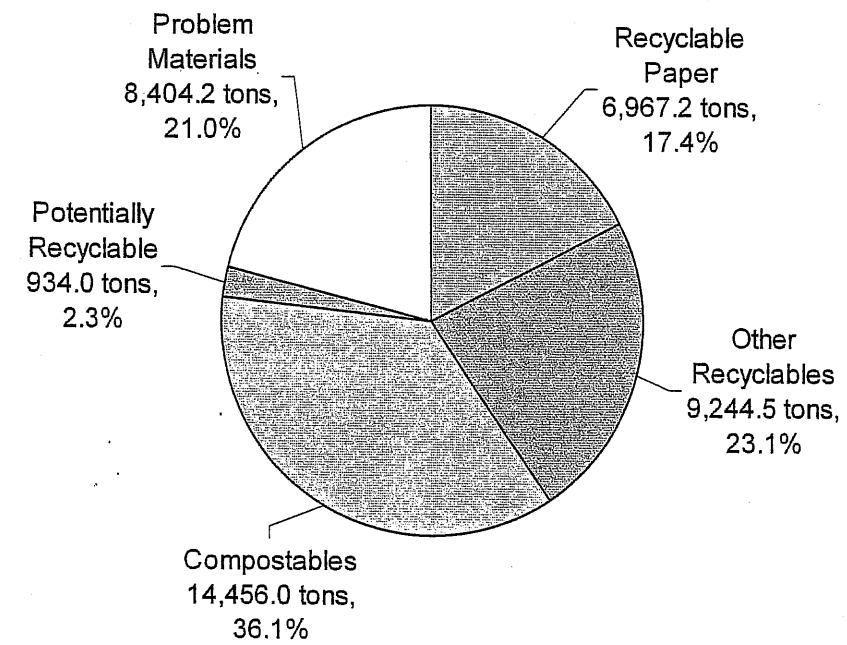


Table 4-6. Detailed Waste Composition, SMaRT Station Residuals

	Est. Mean	+/-	Est. Tons		Est. Mean	+/-	Est. Tons
Paper	27.4%		10,966.7	Organics	27.5%		11,004.3
Uncoated Corrugated Cardboard	2.8%	0.7%	1,118.9	Food	15.2%	3.5%	6,061.1
Paper Bags/Kraft	0.6%	0.2%	251.9	Tires	0.1%	0.2%	47.0
White Ledger	1.8%	0.4%	716.5	Other Rubber	0.5%	0.2%	189.4
Computer Paper	0.0%	0.0%	0.9	Wood Pallets	0.4%	0.6%	159.2
Newspaper	3.6%	0.7%	1,452.0	Wood-untreated	0.9%	0.6%	351.0
Magazines and Catalogs	3.2%	0.8%	1,260.9	Wood-treated	2.4%	1.9%	946.9
Phone Books and Directories	0.1%	0.1%	51.0	Agricultural Crop Residues	0.0%	0.0%	0.0
Colored Ledger	0.1%	0.0%	53.7	Manure	0.1%	0.1%	38.1
Other Office Paper	1.7%	0.5%	687.3	Textiles	1.7%	0.4%	671.8
Milk & Juice Polycoated Containers	0.4%	0.1%	166.3	Leather	0.1%	0.1%	48.3
Hardcover Books	0.0%	0.0%	12.0	Diapers	3.7%	1.2%	1,482.6
Other Misc. Paper	3.0%	0.5%	1,190.0	Carpet	0.3%	0.2%	118.4
Compostable Paper	9.0%	1.5%	3,589.7	Carpet Padding	0.0%	0.0%	0.0
Blueprints	0.0%	0.0%	5.8	Compostable Organics	0.8%	1.1%	332.0
Remainder/Composite Paper	1.0%	0.3%	409.8	Remainder/Composite Organics	1.4%	0.6%	558.4
Plastic	12.3%		4,919.3	Construction & Demolition	12.9%		5,146.8
HDPE Containers	0.6%	0.2%	227.1	Concrete	0.3%	0.3%	130.8
PET Containers	0.5%	0.1%	206.7	Asphalt Paving	0.0%	0.0%	0.0
Misc. Plastic Containers	1.6%	0.3%	645.9	Rock, Soil, and Fines	5.4%	1.7%	2,177.3
Plastic Bags	1.5%	0.6%	604.9	Gypsum Board	2.8%	2.4%	1,129.1
Other Film Plastics	5.1%	0.7%	2,027.0	Asphalt Roofing	0.2%	0.2%	87.8
Durable Plastic Items	0.8%	0.2%	325.1	Remainder/Composite C&D	4.1%	2.9%	1,621.7
Expanded Polystyrene Packaging	0.4%	0.1%	145.6	Hazardous Waste	0.0%		15.5
Expanded Polystyrene Containers	0.8%	0.3%	310.1	Paint	0.0%	0.0%	4.9
Remainder/Composite Plastic	1.1%	0.3%	426.9	Antifreeze	0.0%	0.0%	0.0
Glass	1.1%		454.6	Vehicle and Equipment Fluids	0.0%	0.0%	0.0
Clear Glass Bottles and Containers	0.6%	0.2%	233.7	Used Oil	0.0%	0.0%	0.0
Green Glass Bottles and Containers	0.2%	0.1%	78.5	Treated Medical Waste	0.0%	0.0%	0.0
Brown Glass Bottles and Containers	0.2%	0.2%	77.2	Batteries	0.0%	0.0%	7.5
Flat Glass	0.0%	0.0%	19.5	Auto Batteries	0.0%	0.0%	0.0
Other Colored Bottles & Containers	0.0%	0.0%	2.2	Fluorescent Lights	0.0%	0.0%	3.1
Remainder/Composite Glass	0.1%	0.0%	43.5	Remainder/Composite HHW	0.0%	0.0%	0.0
Metal	5.3%		2,137.3	Special Waste	2.2%		887.4
Aluminum Cans	0.2%	0.0%	72.7	Mattresses	0.0%	0.0%	0.0
Other Non-ferrous Metal	0.5%	0.2%	195.7	Box Springs	0.0%	0.0%	0.0
Tin/Steel Cans	0.8%	0.3%	321.1	Other Bulky Items	0.0%	0.0%	0.0
Other Ferrous Metal	2.3%	1.9%	921.6	Ash	0.0%	0.0%	0.0
Major Appliances	0.0%	0.0%	0.0	Sewage Solids	0.0%	0.0%	0.0
Engines and Motors	0.0%	0.0%	0.0	Industrial Sludge	0.0%	0.0%	0.0
Remainder/Composite Metal	1.6%	0.9%	626.2	Hypodermic Needles	0.0%	0.0%	1.3
Electronic Waste	0.1%		39.0	Pharmaceutical Medications	0.0%	0.0%	0.9
Brown Goods	0.0%	0.0%	0.0	Remainder/Composite SW	1.8%	2.0%	718.9
Computer-related Electronics	0.0%	0.0%	2.7	Mixed Residue	0.4%	0.3%	166.3
Other Small Consumer Electronics	0.1%	0.1%	31.5				
TVs and Other Items with CRTs	0.0%	0.0%	4.9				
Yard	11.1%		4,435.0				
Leaves and Grass	10.5%	2.6%	4,185.8				
Prunings and Trimmings	0.4%	0.2%	161.4				
Branches and Stumps	0.2%	0.4%	87.8				

Samples: 30
2004 Tons: 40,006.0

Appendix C. Waste Sort Analytical Procedures

To develop waste characterization and quantity profiles for this study, four main steps were taken. These steps are as follows:

- 1. Convert volumetric estimates of material categories to weight (for industrial and self-haul visual characterization estimates).
- 2. Calculate the estimated composition of all samples in a given sector, based on the sample weight.
- 3. Combine the results for the four individual sectors, using a weighted average procedure, to produce findings for the City Overall.
- 4. Apply tonnage figures for waste to the composition estimates, to derive tonnage estimates for each material.

Converting Volumes to Weights

The composition calculations rely on the availability of individual material weights for each sample. For industrial and self-haul samples, Cascadia converted volume estimates to weights using accepted waste density conversion factors. These factors are listed in Table C-2 at the end of this appendix, and data sources accompany the table.

Using the volume-to-weight conversion factors and the volume estimates obtained during the characterization of visual samples, individual material weights were calculated using the following formula:

$$c = m \times s \times v \times d$$

where:

- m = percentage estimate of the material, as a portion of material class (e.g., the extent to which newspaper constitutes all of the paper in the sample)
- s = percentage estimate of the material class, as a portion of all of the material in the sample (e.g., the extent to which paper constitutes all of the material in the sample)
- v = total volume of the sample (in cubic yards)
- d = density conversion of the material (in pounds/cubic yard)
- c = the total weight of the specific material in the sample

Each material weight was than scaled so that the sum of all material weights equaled the actual total sample weight (or net weight of the load).

Composition Calculations

The composition estimates represent the **ratio of the material categories' weight to the total waste** for each noted sector. They are derived by summing each material's weight across all of the selected records and dividing by the sum of the total weight of waste, as shown in the following equation:

$$r_j = \frac{\sum_i c_{ij}}{\sum_i w_i}$$

where:
c = weight of a particular material
w = sum of all material weights
for i = 1 to n
where n = number of selected samples
for j = 1 to m
where m = number of material categories

The confidence interval for this estimate is derived in two steps. First, the variance around the estimate is calculated, accounting for the fact that the ratio includes two random variables (the material and total sample weights). The **variance of the ratio estimator** equation follows:

$$\hat{V}_{r_j} = \left(\frac{1}{n}\right) \cdot \left(\frac{1}{\bar{w}^2}\right) \cdot \left(\frac{\sum_i \left(c_{ij} - r_j w_i\right)^2}{n-1}\right)$$

where:

$$\bar{w} = \frac{\sum_i w_i}{n}$$

Second, **precision levels** at the 90% confidence interval are calculated for a material’s mean as follows:

$$r_j \pm \left(t \cdot \sqrt{\hat{V}_{r_j}}\right)$$

where:
t = the value of the t-statistic (1.645) corresponding to a 90% confidence level

For more detail, please refer to Chapter 6 “Ratio, Regression and Difference Estimation” of Elementary Survey Sampling by R.L. Scheaffer, W. Mendenhall and L. Ott (PWS Publishers, 1986).

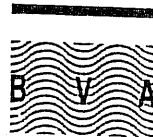
Weighted Averages

The overall City waste composition estimates were calculated by performing a weighted average across the four waste sectors. The weighting percentages that were used to perform the overall composition calculations are listed in Table C-1 below.

Appendix I: Remainder/Composite Material Categories

	Definition	Examples observed during field work:	What makes them unrecoverable?
Remainder/Composite Paper	R/C Paper means items made mostly of paper but combined with large amounts of other materials such as plastic, glues, and foil. Examples include non-juice aseptic packages, sepia, onion skin, aluminum lined fast food wrappers, carbon paper, self-adhesive notes, and photographs.	aluminum lined fast food wrappers, self-adhesive notes, photos 3-ring binders	The different material components are difficult to separate. Paper is attached to other materials (glue/foil/plastic/metal)
Remainder/Composite Plastic	R/C Plastic means plastic that cannot be put in any other type. They are usually recognized by their optical opacity. This type includes items made mostly of plastic but combined with other materials. Examples include auto parts made of plastic attached to metal, plastic drinking straws, plastic strapping, plastic lids, some kitchen ware, toys made of plastic and other materials, new plastic laminate (e.g., Formica), vinyl, linoleum, plastic lumber, non-PS insulating foams, imitation ceramics, handles and knobs, plastic string (such as is used for hay bales), and plastic rigid bubble/foil packaging (as for medications).	drinking straws, single-use cutlery, soda lids, toys, hangers, plastic strapping, bubble/foil packaging, fridge door, tarps w/ metal attached	Mixed resin products are typically difficult to recycle, plastic toys are difficult to repair.
Remainder/Composite Glass	R/C Glass means glass that cannot be put in any other type. It includes items made mostly of glass but combined with other materials. Examples include Pyrex, Corningware, crystal and other glass tableware, mirrors, non-fluorescent light bulbs, and auto windshields.	glass cups, jars with some candle wax, light bulbs	The different material components are difficult to separate.
Remainder/Composite Metal	R/C Metal means metal that cannot be put in any other type. This type includes items made mostly of metal but combined with other materials and items made of both ferrous metals and non-ferrous metal combined. Examples include finished and non-finished products that contain a mixture of metals, or metals and other materials, whose weight is derived significantly from the metal portion of its construction. Includes insulated wire.	insulated wiring, power cords, pots and pans (with handles attached), ironing board with covering attached, fan, bbq grill (with rubber wheels and wooden side panels	The different material components are difficult to separate.
Remainder/Composite Organics	R/C Organics means organic material that cannot be put in any other type or subtype. This type includes items made mostly of organic materials but combined with other materials. Examples include cigarette butts, and animal feces.	animal feces, air filters	The different material components are difficult to separate. Pathogen concerns with animal feces.
Remainder/Composite HHW	R/C HHW means material that cannot be put in any other type. This type also includes household hazardous material that is mixed. Examples include household hazardous waste which if improperly put in the solid waste stream may present handling problems or other hazards, such as pesticides, and caustic cleaners.	cleaning fluid, other products with caution/warning/danger caution words on product label	Cost.
Remainder/Composite C&D	R/C C&D means construction and demolition material that cannot be put in any other type. This type may include items from different categories combined, which would be very hard to separate. Examples include brick, ceramics, tiles, toilets, sinks, dried paint not attached to other materials, and fiberglass insulation. This type may also include demolition debris that is a mixture of items such as plate glass, wood, tiles, gypsum board, and aluminum scrap.	bricks, household ceramics, fiberglass insulation, ceiling tiles, cement board, tar paper, gypsum stuck to other materials such as wood	Some RC C&D may be recoverable, depending on markets (i.e. bricks). With demo material, the different material components are difficult to separate. If buildings are deconstructed versus demo, more effective to recycle
Remainder/Composite Special Waste	R/C Special Waste means special waste that cannot be put in any other type. Examples include asbestos-containing materials, such as certain types of pipe insulation and floor tiles, auto fluff, auto-bodies, trucks, trailers, truck cabs, untreated medical waste (such as tubing and soiled gowns), and artificial fireplace logs.	primarily medical waste	Bio hazard makes recycling med waste difficult.

DSARGENT



**SMaRT Station
Waste Characterization Study**

Draft Report

October 19, 1995

Prepared for

**City of Sunnyvale
City of Mountain View
City of Palo Alto
Western Waste Industries**

Prepared by

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Table 3-12
Subwastestreams of Each City, All Sources

Material Type	Mountain View				Palo Alto				Sunnyvale				Public Haul
	Residential	Commercial	Industrial	Total	Residential	Commercial	Industrial	Total	Residential	Commercial	Industrial	Total	Total
Cardboard	0.76%	1.64%	0.14%	2.55%	0.39%	2.01%	0.25%	2.65%	0.65%	1.90%	1.50%	4.15%	0.00%
Cardboard(C)	0.66%	2.55%	0.01%	3.22%	0.61%	3.65%	0.13%	4.39%	0.92%	0.85%	0.21%	1.98%	0.00%
Newspaper	1.39%	1.52%	0.02%	2.92%	0.54%	0.88%	0.06%	1.47%	0.73%	2.74%	0.40%	3.88%	0.00%
Newspaper (C)	0.56%	0.20%	0.00%	0.76%	0.36%	0.67%	0.01%	1.03%	0.29%	0.78%	0.03%	1.11%	0.00%
Mixed Waste Paper	2.02%	2.07%	0.08%	4.17%	2.06%	4.52%	1.44%	8.01%	1.69%	2.22%	1.38%	5.80%	0.03%
Mixed Waste Paper (C)	2.69%	2.06%	0.00%	4.76%	1.64%	3.19%	0.00%	4.83%	1.55%	2.38%	0.29%	4.22%	0.00%
High Grade	0.28%	0.75%	0.01%	1.04%	0.20%	2.02%	0.49%	2.70%	0.12%	0.46%	0.77%	1.34%	0.00%
High Grade (C)	0.06%	0.03%	0.00%	0.09%	0.06%	0.38%	0.01%	0.44%	0.04%	0.07%	0.03%	0.14%	0.00%
Other Paper	3.27%	2.65%	0.07%	6.00%	2.44%	7.67%	0.56%	10.67%	2.61%	3.07%	0.30%	6.48%	0.00%
Aluminum Cans	0.11%	0.08%	0.00%	0.19%	0.05%	0.14%	0.01%	0.19%	0.07%	0.16%	0.02%	0.25%	0.00%
Tin Cans	0.26%	0.19%	0.00%	0.45%	0.18%	0.52%	0.00%	0.71%	0.22%	0.33%	0.01%	0.56%	0.00%
Ferrous Metals	0.32%	1.27%	2.74%	4.33%	0.18%	0.76%	1.41%	2.35%	0.34%	1.08%	0.31%	1.72%	0.18%
Non-Fer. Alum. Scrap	0.07%	0.12%	0.37%	0.56%	0.06%	0.13%	0.00%	0.20%	0.09%	0.15%	0.01%	0.25%	0.00%
Bi-Metals	0.04%	0.01%	0.00%	0.05%	0.03%	0.02%	0.00%	0.05%	0.07%	0.02%	0.01%	0.10%	0.00%
CA Redemption Glass	0.14%	0.37%	0.01%	0.52%	0.13%	0.34%	0.04%	0.51%	0.16%	0.28%	0.07%	0.51%	0.00%
Non-Recyclable Glass	0.07%	0.07%	0.00%	0.14%	0.07%	0.11%	0.63%	0.81%	0.02%	0.09%	0.00%	0.11%	0.18%
Other Recyclable Glass	0.36%	0.58%	0.00%	0.94%	0.28%	0.76%	0.03%	1.08%	0.30%	0.59%	0.09%	0.98%	0.00%
Refill. Glass Container	0.00%	0.01%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1 - PET	0.11%	0.12%	0.00%	0.23%	0.07%	0.25%	0.00%	0.32%	0.14%	0.13%	0.02%	0.30%	0.00%
2 - HDPE	0.13%	0.17%	0.00%	0.30%	0.14%	0.37%	0.01%	0.52%	0.31%	0.34%	0.08%	0.72%	0.00%
3 - PVC	0.00%	0.01%	0.00%	0.02%	0.00%	0.02%	0.00%	0.03%	0.01%	0.07%	0.00%	0.08%	0.00%
4 - LDPE	0.01%	0.00%	0.00%	0.01%	0.01%	0.00%	0.00%	0.02%	0.00%	0.02%	0.00%	0.03%	0.00%
5 - Polypropylene	0.01%	0.01%	0.00%	0.02%	0.04%	0.03%	0.00%	0.08%	0.03%	0.08%	0.00%	0.11%	0.00%
6 - Polystyrene	0.22%	0.26%	0.01%	0.50%	0.16%	0.50%	0.02%	0.67%	0.13%	0.26%	0.12%	0.52%	0.00%
Films	2.11%	2.20%	0.09%	4.40%	1.16%	3.36%	0.48%	5.00%	1.28%	2.04%	0.48%	3.80%	0.00%
Other Plastic	0.57%	0.93%	0.30%	1.80%	0.27%	1.86%	0.17%	2.30%	0.56%	0.76%	0.14%	1.46%	0.00%
Yard Waste-Shrubby	0.34%	0.30%	1.08%	1.72%	0.01%	0.15%	0.12%	0.28%	0.30%	0.28%	4.04%	4.63%	23.60%
Yard Waste-Leafy	0.99%	1.55%	0.60%	3.15%	0.62%	0.47%	2.43%	3.51%	0.55%	1.45%	0.20%	2.20%	0.00%
Yard Waste-Collected	5.76%	0.00%	0.00%	5.76%	0.00%	0.00%	0.00%	0.00%	10.31%	0.00%	0.00%	10.31%	0.00%
Wood Waste	0.55%	3.69%	4.32%	8.55%	0.14%	0.69%	1.31%	2.14%	0.62%	0.90%	3.48%	5.00%	2.18%
Agricultural Crop Residue	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Manure	0.07%	0.00%	0.00%	0.07%	0.21%	0.01%	0.00%	0.22%	0.00%	1.60%	0.00%	1.60%	0.00%
Food Waste	2.59%	2.98%	0.00%	5.57%	3.80%	10.93%	0.04%	14.77%	3.56%	3.23%	0.41%	7.19%	0.00%
Textiles	1.23%	0.93%	0.44%	2.60%	0.73%	0.93%	0.20%	1.85%	1.11%	1.84%	0.71%	3.67%	0.00%
Leather	0.05%	0.02%	0.00%	0.07%	0.04%	0.00%	0.00%	0.05%	0.00%	0.01%	0.00%	0.01%	0.00%
Household Haz. Waste	0.11%	0.30%	0.01%	0.42%	0.02%	0.14%	0.00%	0.16%	0.11%	0.09%	0.05%	0.25%	0.00%
Inert Solids	0.45%	0.12%	3.96%	4.53%	0.44%	0.22%	0.61%	1.27%	0.15%	0.84%	0.43%	1.42%	18.56%
Diapers	0.87%	0.05%	0.01%	0.92%	0.83%	0.21%	0.00%	1.04%	0.97%	0.74%	0.01%	1.72%	0.00%
Tires & Rubber	0.05%	0.44%	0.04%	0.53%	0.03%	0.32%	0.03%	0.38%	0.07%	0.08%	0.04%	0.19%	0.56%
White Goods	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.34%	0.34%	0.00%	0.13%	0.00%	0.13%	0.00%
Remainder	5.98%	6.61%	13.57%	26.17%	4.24%	8.65%	10.06%	22.95%	6.34%	8.25%	6.49%	21.09%	54.70%
Total	35.24%	36.86%	27.90%	100.00%	22.22%	56.89%	20.88%	100.00%	36.46%	40.29%	23.24%	100.00%	100.00%
Total Tons	1,336.19	1,397.63	1,057.89	3,791.71	596.23	1,526.43	560.29	2,682.95	2,169.40	2,397.12	1,382.59	5,949.11	325.80

Note: To calculate the tons of a component, multiply total tons from a City by the component percentage. For example, to calculate tons of OCC from Mt. View residential, multiply Mt. View's total tons, 3,791.71 tons by .76% to equal 28.8 tons.